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First record of the non-native Chinese stripe-necked turtle (*Mauremys sinensis* Gray, 1834) from the island of Lesvos, Greece

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Abstract

The number of alien freshwater turtle records has increased in Greece in recent years. These species happen to be high in demand by the aquatic pet trade, and thus anthropogenic mediation has facilitated their dispersal beyond any natural barriers. The deleterious effects of these species on native biodiversity have long been documented. Here, we report for the first time the presence of the Chinese stripe-necked turtle (*Mauremys sinensis*) on the island of Lesvos, Greece. Lesvos Island has been heavily monitored in the past, revealing the presence of *Trachemys scripta*. *Mauremys sinensis* is now the second invasive species on an island, where the population of *Emys orbicularis* is decreasing faster than previously expected. We urge swift action to assess the population status of the newly discovered invasive species as well as the added effects it may have along with *T. scripta* on the two native species, *Emys orbicularis* and *Mauremys rivulata*.

Key Words

alien species, freshwater, Mediterranean, terrapin, Testudines

Invasive alien species (IAS) are defined as non-native species that owe their presence to direct, intentional, or accidental human intervention that facilitates a species' dispersal beyond biogeographical barriers, causing impacts on the economy, the environment, and/or human, domestic animal, or farm animal health (Richardson et al. 2000; Lovell et al. 2006; Pejchar and Mooney 2009; Schindler et al. 2015; Pysek et al. 2020). More specifically, such species disrupt ecosystem function in a variety of ways. They alter food-web structures (David et al. 2017), they compromise ecosystem services, and they threaten native populations through competition for resources, predation, pathogen introduction (Kilpatrick et al. 2011; Mihalca 2015), habitat modification (David et al. 2017), or even hybridization with native species (Beukema et al. 2015). Island ecosystems happen to be even more vulnerable to IAS (Vitousek 1996; Russell et al. 2017) due to their unique evolutionary history and ecological isolation (Ricklefs and Losos 2009). Native species often lack defense mechanisms against IAS (Carlquist 1965), while the absence of certain functional groups further weakens these insular ecosystems (Cushman 1995). It has been previously established that IAS pose a serious threat to native biodiversity within the Mediterranean basin (Galil 2007). Pond turtles rank among the most commonly traded species in the aquarium pet trade industry (Bush et al. 2014; Luiselli et al. 2016), and there are many studies that highlight the above negative effects, especially those of *Trachemys scripta* (Cadi et al. 2004; Polo-Cavia et al. 2010; Mali et al. 2014). These species have a high introduction risk (Masin et al. 2014) and are either released intentionally by reptile keepers or accidentally escape their

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enclosures, making their way to nature. There, they can successfully establish populations, often outcompeting native species (Ficetola et al. 2009). Within the European aquatic ecosystems, non-native reptiles include at least thirteen alien freshwater turtle species (Kalaentzis et al. 2023; Nekrasova et al. 2024).

In Greece, seven invasive turtle species have been recorded to date (Kalaentzis et al. 2023), including two subspecies of *Trachemys scripta*, *T. scripta scripta* (Schoepff, 1792) and *T. scripta elegans* (Wied, 1838), the Florida red-bellied cooter *Pseudemys nelsoni* (Carr, 1938), the Eastern river cooter *Pseudemys concinna* (Le Conte, 1830), the Chinese stripe-necked turtle *Mauremys sinensis* (Gray, 1834), the Chinese soft-shelled turtle *Pelodiscus sinensis* (Wiegmann, 1835), and the common snapping turtle *Chelydra serpentina* (Linnaeus, 1758). *Trachemys scripta* has been documented on the mainland of Greece and across several Aegean islands (Christopoulos and Zevgolis 2022; Kalaentzis et al. 2023). Lesvos, the third largest island in Greece, is located in the northeastern Aegean Sea; it spans 1,632 km^2, and it hosts numerous natural springs and wetlands (Vujic et al. 2007, Zotos et al. 2024). Two native freshwater turtle species inhabit the island, the Western Caspian turtle *Mauremys rivulata* (Broggi 2012) and the European pond turtle *Emys orbicularis* (Broggi 2023). While *M. rivulata* populations are abundant on the island, *E. orbicularis* is found in significantly lower numbers, and the two subspecies of *Trachemys scripta* have also been recorded (Christopoulos and Zevgolis 2022; Broggi 2023). *Trachemys scripta* has also been recognized as one of the hundred most invasive species globally (Lowe et al. 2000), and subsequently, its sale was banned in the European pet trade through regulation 1143/2014 and its implementation 2016/1141 (European Parliament and Council 2014, European Commission 2016). Following this restriction, the pet trade shifted to other turtle species that have been farmed on a massive scale in China, including *Mauremys reevesii* and *Mauremys sinensis* (Maceida-Veiga et al. 2019). In Greece, all non-native species fall under the 3937/2011 regulation that stresses their timely identification and eradication (Greek Parliament 2011). Herein, we present evidence of *Mauremys sinensis* being present on the island of Lesvos. During a fieldwork expedition in August 2024 at approximately 15:00 hours, three adult individuals of the species *Mauremys sinensis* were recorded alongside three adult *Emys orbicularis* individuals and over twenty-five *Mauremys rivulata* individuals in a medium-sized artificial pond (55 m length, 17 m width, approximately 2 m deep). The pond is located at the eastern part of Lesvos (39°16.015'N, 26°5.0983'E), commonly known as the "Terrapin pool," less than 1 km from the village of Skalochori. The identification of the non-native species was made while the first individual was spotted basking and can be highlighted by the unique dorsal and lateral head and neck patterns. Unfortunately, we were able to photograph only one of the individuals while in the water (Fig. 1). This is the first record of the species from a Greek island.

The Chinese stripe-necked turtle *Mauremys sinensis* is naturally distributed throughout China, Taiwan, Laos, and Vietnam (Dijk et al. 2014). It has also been documented as a non-native species in South Korea (Rahman et al. 2024), Spain (Sancho et al. 2020), Portugal (Rato et al. 2024), Italy (Di Blasio et al. 2021), and Slovakia (Jablonski et al. 2018). These occurrences demonstrate the adaptability of the species and its ability to thrive in a variety of different habitats if given the opportunity. In Greece, it has been previously recorded only in the

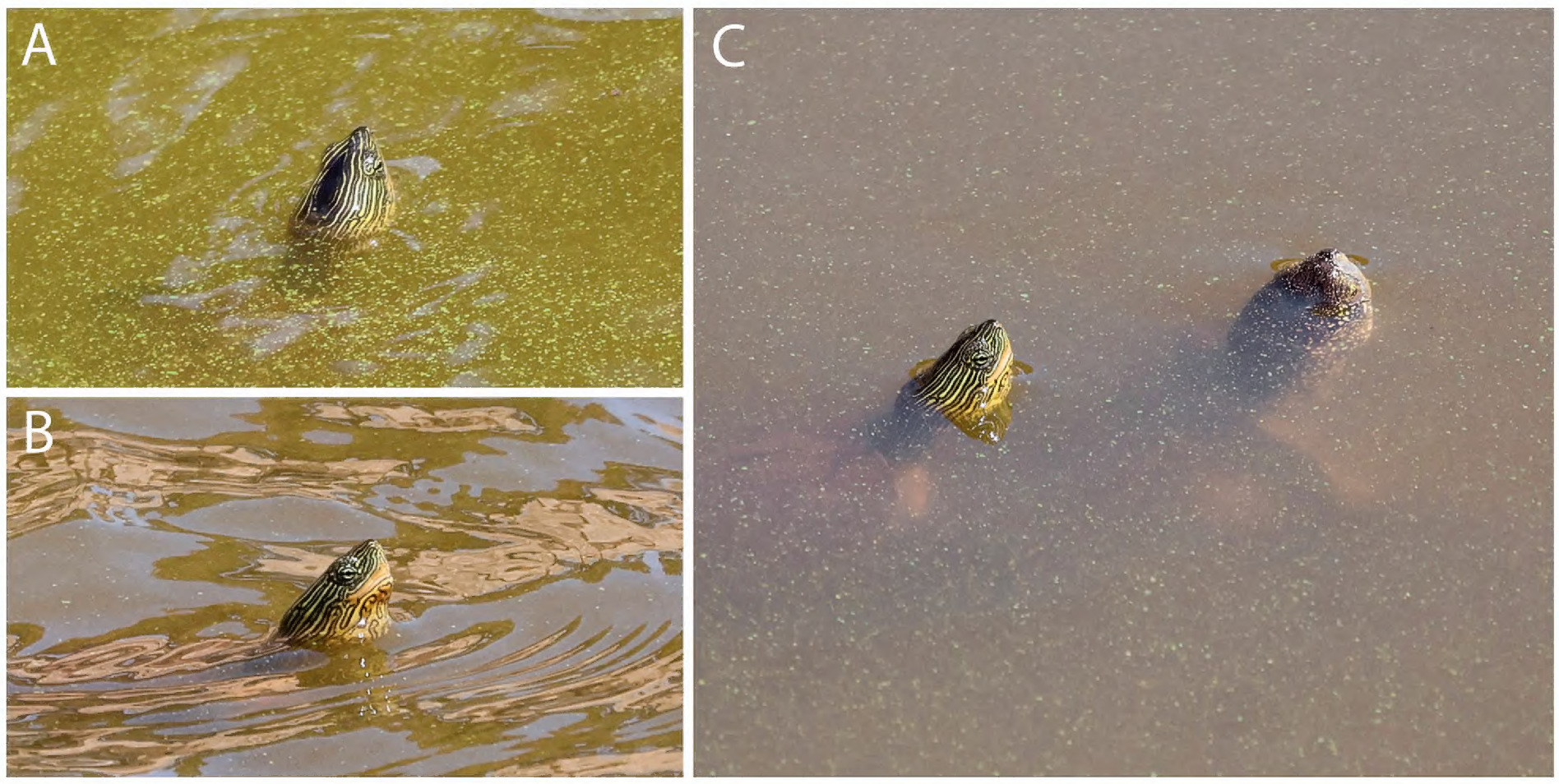

Figure 1. First adult individual of the species *Mauremys sinensis* (Gray, 1834) encountered by the authors: **A.** Dorsal head view; **B.** Lateral head view; **C.** Same individual along with an adult individual of the species *Emys orbicularis* in the "Terrapin pool."

mainland in three different locations (Kalaentzis et al. 2023). Our recent observation adds a second non-native alien turtle species on the island and contributes to the knowledge of the anthropogenic expansion of the species, underscoring the need to investigate both its ecological impact on the different habitats and on native species, especially on those with already dwindling numbers such as *Emys orbicularis*. *Mauremys sinensis* has been previously documented to successfully hybridize with other species of the genus *Mauremys*, like *reevesii* (Xia et al. 2011; Baek et al. 2024), *japonica* (Suzuki et al. 2013), and *leprosa* (Sancho et al. 2020), as well as with different genera such as *Cyclemys* (Schilde et al. 2004) and *Sacalia* (Buskirk et al. 2005). A watchful eye has to be kept over the newly discovered population on the island where the native species *Mauremys rivulata* and *Emys orbicularis* are present. Overall, the presence of *Mauremys sinensis* individuals in a pond on the island of Lesvos is worrisome. Both native turtle species could be potentially impacted by the added effect of the presence and possible population expansion of these. Negative effects on native terrapin populations, like disease transmission and competition for food or basking spots, have been previously documented (Polo-Calvia 2010; Martinez-Rios et al. 2022). Managing IAS effectively requires timely removal and further preventative measures. Both of these depend on early detection, allowing for swift implementation of response measures before population booms, with greater efficiency and lower costs (Wittenberg and Cock 2001; Caffrey et al. 2014). Eradication and control programs for *T. scripta*, like the LIFE TRACHEMYS project, have been adopted in the past, and challenges for confirming such eradication attempts have also been highlighted (Garcia et al. 2017). These challenges underline the need for extensive monitoring efforts on Lesvos Island to further assess the status of *Mauremys sinensis*.

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